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ABSTRACT

Recent findings are reported on the ongoing research related to the socioeconomic career attainment process utilizing the Malmo data set from Sweden as reported in ED 097 268. The general proposition tested is that the association between selected personality resource assets and the desired outcomes of resource conversion settings will be different for different levels or types of resource settings. It is found that (1) the interaction of children's early abilities and their family socioeconomic environments has strong effects on future educational attainments; (2) the interaction of early ability and educational attainment has a low but significant impact on the development of ability at maturity; (3) the two interactions between educational attainment and job status, and between ability at maturity and job status account for variance in earnings over and above the direct effects of ability at maturity and job status; and (4) the impact of schooling on net earnings of job status and ability at maturity is neglible. Attention is given to the relevance of these findings for the development of status attainment theory, and some suggestions are made for extending the analysis by fitting more accurate statistical models. Tables and graphs illustrate the findings throughout the document.
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Education and the Socioeconomic Career II

A Model of the Resource Conversion Properties of Family, School, and Occupational Environments

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STOCKHOLMS UNIVERSITET

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Research Notes from the Malmö Study

Jeffrey W. Bulcock
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ABSTRACT

This study reports recent findings on the ongoing research related to the socioeconomic career attainment process utilizing the Malmö data set from Sweden. The general proposition was tested that the association between selected personality resource assets and the desired outcomes of resource conversion settings would be different for different levels or types of resource setting. Four hypotheses generated by this proposition were tested within the framework of the extended Malmö model of the socioeconomic career. The interaction of children's early abilities and their family socioeconomic environments was found to have a strong positive effect on their future educational attainments. The interaction of early ability and educational attainment had low negative, but significant impact on the development of ability at maturity. The two interactions between educational attainment and job status, and between ability at maturity and job status accounted for variance in earnings over and above the direct effects of ability at maturity and job status. The impact of schooling on earnings net of job status and ability at maturity was negligible. Some attention was given to the relevance of these findings for the development of status attainment theory; and some suggestions made for extending the analysis by fitting more accurate statistical models. The main conclusion reached was that the multiplicative aspects of the process accounted for disproportionate advantages for individuals with personal assets readily convertible into additional assets.

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> "How do education and training affect lifetime income? Are they worth their cost? The evidence answers. Decidedly yes." (Samuelson, 1964:118)
> "Rate of return estimates do tell us that efforts to keep everyone in school longer make little economic sense. The average rate of return for postsecondary education is quite low." (Jencks et al. 1972:224)

1. INTRODUCTION: THE PROBLEM

The two quotations are typical of several statements that could be selected to illustrate the point that the vociferous confidence of the '60's has been replaced by a more subdued caution in the '70's insofar as estimates of returns to schooling are concerned.[2] The flurry of activity by sociologists and economists on this and allied questions has been optimistically referred to as a "paradigm shift",[3] and the interim between Samuelson's statement and the present has been characterized by a remarkable convergence in the underlying logic of inquiry peculiar to the two disciplines. Neither are as independent of one another as in the recent past.

Differences in the concepts used and in emphases, however, continue to prevail, providing a healthy diversity indispensible to creative research effort. Thus, economists have been particularly concerned with the testing of those theories conceptualizing education as a process of human capital formation;[4] whereas sociological models of school impact have been broadly conceived as components in the socioeconomic attainment process.[5]

In an earlier paper the authors (1974) investigated the cross-cultural replicability of the Duncan (1968a) ability and career achievement model as modified by Jencks et al. (1972).[6] Though a major purpose of the study was to examine the question of the extent to which schooling affected subsequent socioeconomic achievements (occupation and income) directly, the conclusion was reached that the functional

form of the additive linear model might not be adequate to the task. The purpose of the present paper is to update current research endeavour on this controversial question.

Aside from the comparative sociological aspects of the problem, there are two dilemmas. The first concerns the extent to which schooling - both quantitative and qualitative - net of job status and ability at maturity, affect earnings. The second concerns the apparent inadequacy of career attainment models to explain much more than a modest twenty per cent of the variance in individual earnings.

The case for comparative studies is sufficiently well established as to be practically self-evident. Cross-cultural investigations, for example Lydall (1968), supplement those conducted on single national systems. Some structural constants within national systems may vary across nations, and the provision of different means and ranges for predetermined variables provide different estimates for the effects of parallel institutional structures; all of which stimulate hypothesis formulation and testing as well as providing base line estimates for further comparative research (Anderson, 1974).

Just as it is unlikely that fine-grained relationships can be examined using the usually gross measures gathered by survey-type instruments, it is similarly unlikely that the simple addition of new variables to current socioeconomic career models will account for much greater explanatory power. In terms of the research methodology used, and in terms of the variable specification of current models then, it is possible that some recent research is approaching a limit of usefulness. Of the numerous further possibilities the one which is explored here concerns the functional form of prevailing models.

The next section of the paper provides a brief overview to current sociological approaches to the issues, which is

followed by a theoretical rationale for modifying the functional form of these models. Hypotheses suggested by these modifications will be formulated. A data section introduces the reader to the Malmö data set, the subsample used in the subsequent analysis, and the variables used in model specification. After the presentation of the findings there is some discussion of their theoretical implications and some suggestions made for extending ongoing research in returns to schooling issues.

2. MAIN THEORY

The Additive Model

A recurrent theme in the attainment process literature is the notion that schooling accounts for powerful effects on individual career statuses. In particular the hypothesis holds that schooling affects earnings both directly and indirectly via the mediating variables, ability at maturity and occupational status. Nevertheless, the independent effects of schooling, including college impact - notwithstanding the beliefs of the '60's - have not been clearly established (Alwin, 1974). Furthermore, the analysis of survey-type data has tended to account for only limited variation in individual incomes.

Spaeth (1974a: Table 2) in his summary of the findings for the regression of income on background, schooling and prior attainments in eight data sets with from four to six predictors found a range of R^2 coefficients from .087 to .222.[7] In extensions of basic models Griliches and Mason (1972) generated an R^2 of .28, and Spaeth (1974a) by adding six work setting variables to a seven variable model boosted R^2 from .199 to to .266. In their replication on the Malmö data set of the Jencks et al. (1972, Appendix B) model, the authors regressed the natural logarithm of 1971 incomes on eight background and prior attainment variables to obtain an R^2 coefficient of .1703. It is clear that there is a long way to go before the claim can be made that adequately specified models of individual earnings exist.

The question of the direct effect of schooling on earnings, net of background and ability factors, is likely an even more pressing problem than that concerning the adequacy of overall model specification. An added complication has been the embarrassing haste with which the issue has been shifted from the theoretical to the practical realm thereby heightening the likelihood of the findings being misinterpreted, and perhaps misused. On the one hand there are studies by Duncan (1968a), Taubman-Wales (1970, 1973), Griliches-Mason (1972), and de Wolff-van Slijpe (1973) which provide evidence that the rewards of education are substantial; while on the other hand the studies by Jencks et al. (1972), and the authors (1974) are inclined to be more moderate and cautious. In what the authors believe to be a particularly elegant discussion of the problem, Hauser, Sewell, and Lutterman (1973) demonstrate that the coefficients of education on earnings are reduced significantly when the relationship is considered net of job status and ability. In Table 1 summary statistics are presented for six data sets in which the relationships between ability, educational attainment and job status are unambiguous.

The findings presented in Table 1 should be read with caution, because the coefficients based on different data sets, different variable measures, and equations of different complexity are not directly comparable. The coefficients provide impressionistic evidence, however, of the degree of convergence and consistency in current research findings.

Main theory relationships in models of the Duncan variety are presented in Figure 1. The relative effect of P_{52} - schooling on earnings - is the foremost issue.

TABLE 1: PATH COEFFICIENTS (BETAS) AND COEFFICIENTS OF DETERMINATION (R^2) FOR THE REGRESSION OF INCOME ON ABILITY, EDUCATIONAL ATTAINMENT, AND JOB STATUS FROM SIX DATA SOURCES[a]

	DATA SOURCE					
PREDICTORS	Duncan (1968a)[b]	Kohn (1969)[c]	Griliches-Mason (1972)[d]	Jencks *et al.* (1972)[e]	Hauser-Sewell-Lutterman (1973)[f]	Bulcock-Fägerlind-Emanuelsson (1974)
Ability	.13	.086	.00105	.09	.066	.174
Education	.09	.026	.0462	.03	.063	.056
Job Status	.26	.329	-----	.29	.131	.206
R^2	.181	.199	.216	.222	.074	.173

a) The coefficient for ability on income in the Hauser, Sewell, Lutterman (1973) analysis is for the early ability of respondents. In all other data sets the ability measure reported is for ability at maturity; with the exception of the Kohn data later ability is either a direct measure of ability at

(cont'd over)

the time of induction into military service, or the military IQ has been used to obtain a set of correlation coefficients for use in a synthesized data set (e.g., Duncan, 1968a; and Jencks, et al., 1972). All analyses are from U.S. data sources except the Bulcock, Fägerlind, Emanuelsson (1974) analysis. Although income was used as the dependent variable in all the data sets, it was measured differently. Duncan, Kohn, and Jencks used the simple arithmetic measure of income, usually in units of $100. Griliches and Mason, and Bulcock, Fägerlind and Emanuelsson used the natural logarithmic transformation of the arithmetic measure. Hauser, Sewell, and Lutterman used the son's canonically weighted average of 1965, 1966, and 1967 earnings in units of $1,000. Spaeth (1974a) discusses the major similarities and differences in the first four of these data sets.

b) Contains eight variables: EARLYIQ, FAMSZ, FATHED, and FATHOCC as exogenous; EDUC, LATERIQ, OCC64, INC64 as endogenous in the causal order as presented.

c) Figures for the Kohn data set have been taken from Spaeth (1974a: Table 4) who provides beta coefficients for a ten variable model: FATHED, FATHOCC, FAMSZ, LATERIQ, EDUC, OCCSTAT, COMSZ, RELEVJOB, SZFIRM, COMPLEXJ, where the last four mnemonics refer to community size, relevant job experience, size of firm, and job complexity.

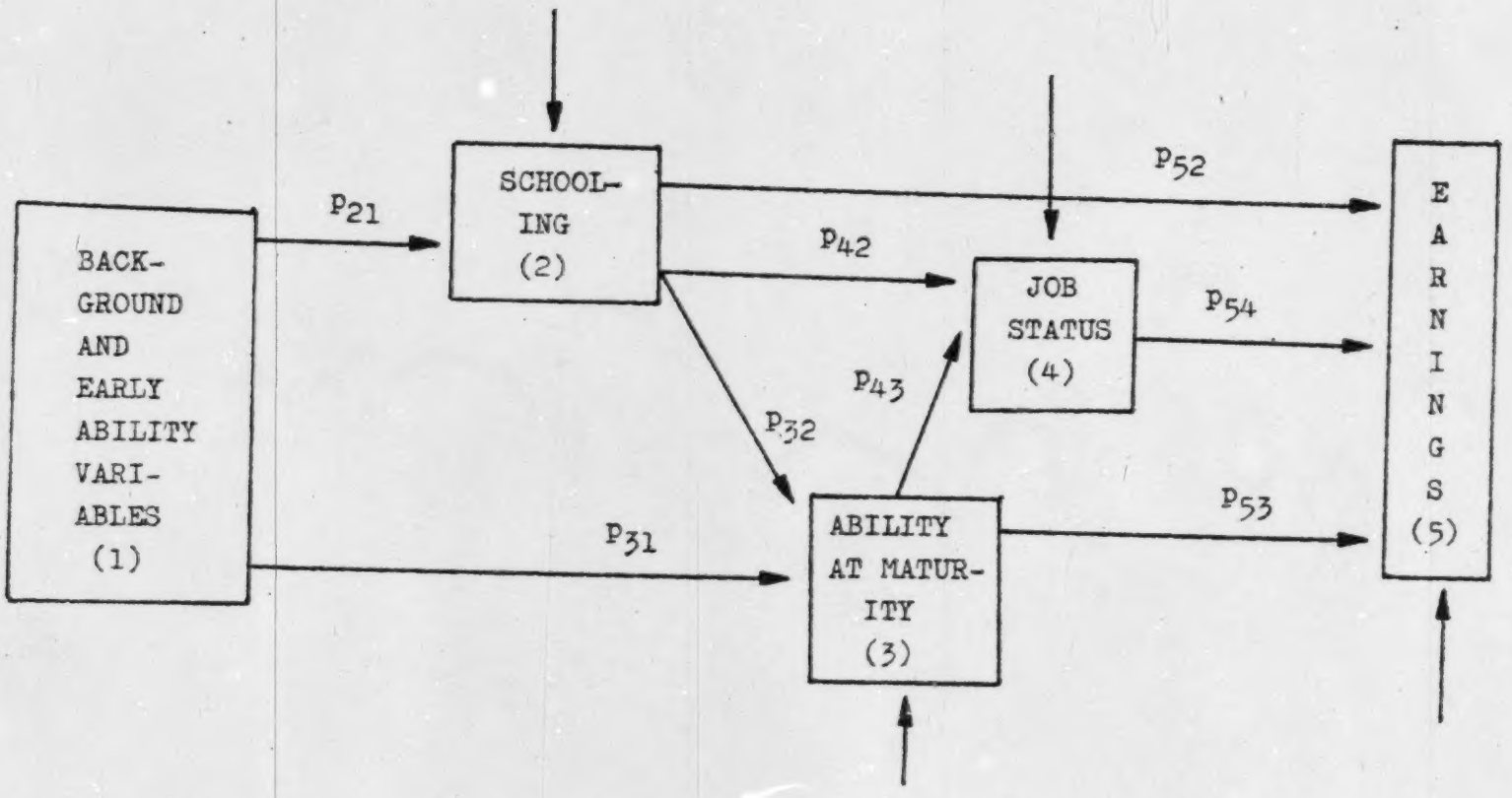
d) The coefficients selected from the Griliches-Mason paper are from equation number 4 which includes eight variables: COLOR, EDUC, SI, LATERIQ, AGE, AMS, FATHSTAT, REGION; where EDUC = years of schooling before military service, SI = the schooling increment or the difference between total number of school grades completed and the total completed before military service, LATERIQ = score on the AFQT (US Armed Forces Qualifying Test), AMS = length of active military service, FATHSTAT = a composite measure of the father's status based on years of father's schooling, and father's occupation coded on the basis of the Duncan 1961 SES scale, REGION = regional classification - the region of the United States where the respondent grew up. Note that the respondent's current job status was not used in equation 4 as a predictor.

(cont'd over)

e) The variables in the Jencks et al., (1972:339, Figure B-1) analysis were the same as the ones used by Duncan (1968a) though Jencks modified the causal ordering slightly - see footnote (b) to this Table. The coefficients are the ones based on "observed" correlations uncorrected for attenuation.

f) The path coefficients are reported in equation 22 in the first panel of Table 3.15 in Hauser, Sewell, and Lutterman (1973). Seven predictors were used: FATHED, MOTHED, OCCSTAT, PARINC, EARLYIQ, EDUC, and OCC64.
*p GT .05

FIGURE 1: SCHEMATIC PATH DIGRAM OF THE INCOME DETERMINATION MODEL



General Theory

A partial solution to the P_{52} issue is conceivable if the impact of schooling on earnings were different for different job status categories. The solution rests on the assumption that returns to schooling for some categories of earners, say, teachers, are different than for others, say, journeymen craftsmen. Inasmuch as a certain level of schooling represents a resource asset for an individual, the extent to which the occupational sphere converts or transforms this resource into resources of other kinds such as authority, responsibility, seniority, and earnings will determine the relative contribution of schooling to socioeconomic career outcomes (cf. Coleman, 1971:2-3). The more likely resource convertibility differs from one job category to another the less the possibility that the additive model will capture these differences, than one which includes appropriate interaction vectors.

The hypothesis may be expressed as follows: that the association of schooling with income will be different for different jobs statuses; or, alternatively, that similar schooling assets will have different capital (convertibility) potential in different occupational settings. It is the range of resource convertibility from occupation to occupation which accounts for the generality of the proposition that, if schooling assets are highly convertible in a particular job setting, then the greater the probability that they will be positively correlated with earnings.

The occupational sphere is only one kind of resource transformation setting. In models of socioeconomic attainment there are minimally two further conversion environments - the family, and the school - which constitute powerful socializing environments. The question arises as to whether family circumstances and school conditions operate differentially on a range of personality inputs (resource assets). More specifically, the issues as to whether different family environments have different resource utilization qualities for a range of personality inputs, or whether

school conditions affect different personality resources differently, are legitimate ones for the development of a theory of the attainment process. Thus, the logic of the resource conversion thesis may be worked out in terms of interactions between personality resources and a variety of interpersonal environments.

In the general case, the proposition may be formulated as follows: that the association between personality resource assets and the desired outcomes of resource conversion settings are different for different levels or types of resource setting. In operationalized terms the proposition generates a set of resource conversion hypotheses.

If we consider the typical Duncan model of the social stratification process,[8] or the Sewell model of status attainment,[9] the resource conversion hypothesis could assume three additional forms. First, that the early ability of children may have disproportionate effects on school attainments according to the type of home socializing environment. Secondly, that the association between early ability and later ability will differ according to type of schooling. Thirdly, that there are significant interactions detectable between later ability and occupational status over and above the additive effects of these two factors on earnings.

Hypothesis Formulation

The additive model as presented in Figure 1 generates three general family background hypotheses, though the actual number would be a multiplicative function of the number of specific background variables included in the analysis.

H1. Family background characteristics will account for modest positive effects on the early cognitive abilities of children.

H2. Schooling attainments - both qualitative and quantitative - will vary positively as a function of the impact of family background characteristics.

H3. Family background effects on job status and earnings will largely be mediated by schooling attainments and ability at maturity.[10]

Three additional hypotheses generated by models of the status attainment process are related to the effects of ability and schooling.

H4. The effects of early ability on subsequent occupational status attainments will be indirect as mediated by schooling attainments and abilities at maturity.

H5. The effect of schooling on occupational status attainments will be both direct and positive.

H6. The effects of schooling on earnings will be largely indirect as mediated by ability at maturity and subsequent of status.

A final hypothesis generated by the additive model is related to relationships between occupational status and earnings.

H7. Variation in earnings will be a direct, positive, partial function of occupational status.

The only departure from the usual additive models is represented by hypothesis number 6 in which the relationship between schooling and earnings is assumed to be largely an indirect one. The hypothesis supports the notion that the effect of schooling on earnings is due to two considerations. First, men with higher levels of schooling will be able to obtain higher status jobs which tend to be better paid jobs. Secondly, men with higher levels of schooling are likely to have abilities at maturity which enable them to cope with the skills demanded of their occupation, thus mediating the effect of schooling on earnings both directly and via occupational status. In short, hypothesis 6 is unconventional because it assumes that the P_{52} (Figure 1) relationship is effectively zero.

Four resource conversion hypotheses which constitute the raison d'être of the current research are based on the main theory propositions.

H8. The effects of early ability on educational attainments will be different for son's from different socio-economic environments or family socialization settings.

H9. The effects of early ability on later ability will be different for different types of schooling, and/or different levels of educational attainment.

H10. The association of schooling attainment with earnings will differ according to job category; and, similarly,

H11. The correlation of ability at maturity with earnings will be different for different job status categories.

Model Specification

The modifications to the additive model suggested by the four resource conversion hypotheses H8 through H11 are schematically presented in Figure 2. It is to be noted that the specific variables selected to test family background effects were father's education, family socioeconomic status, and per capita family income. Though additional variables might have been added to the exogenous set, on the basis of previous analyses their addition would not have provided additional predictive or explanatory power. The mnemonics used in Figure 2 will be the ones used throughout the remainder of the paper. The capital "Z" will be used to represent interaction terms.

Additive Figure 2 relationships are captured by the conventional set of structural equations. The resource conversion hypotheses are testable if the interaction vectors incorporating the hypothesized relationships are added to the model. Since such an addition violates some assumptions underlying the path equation the interaction vectors are shown by dotted lines in the diagram (Figure 2). The structural equations are as follows:

$$X_4 = p_{41}X_1 + p_{42}X_2 + p_{43}X_3 + p_{4s}X_s \quad (1)$$

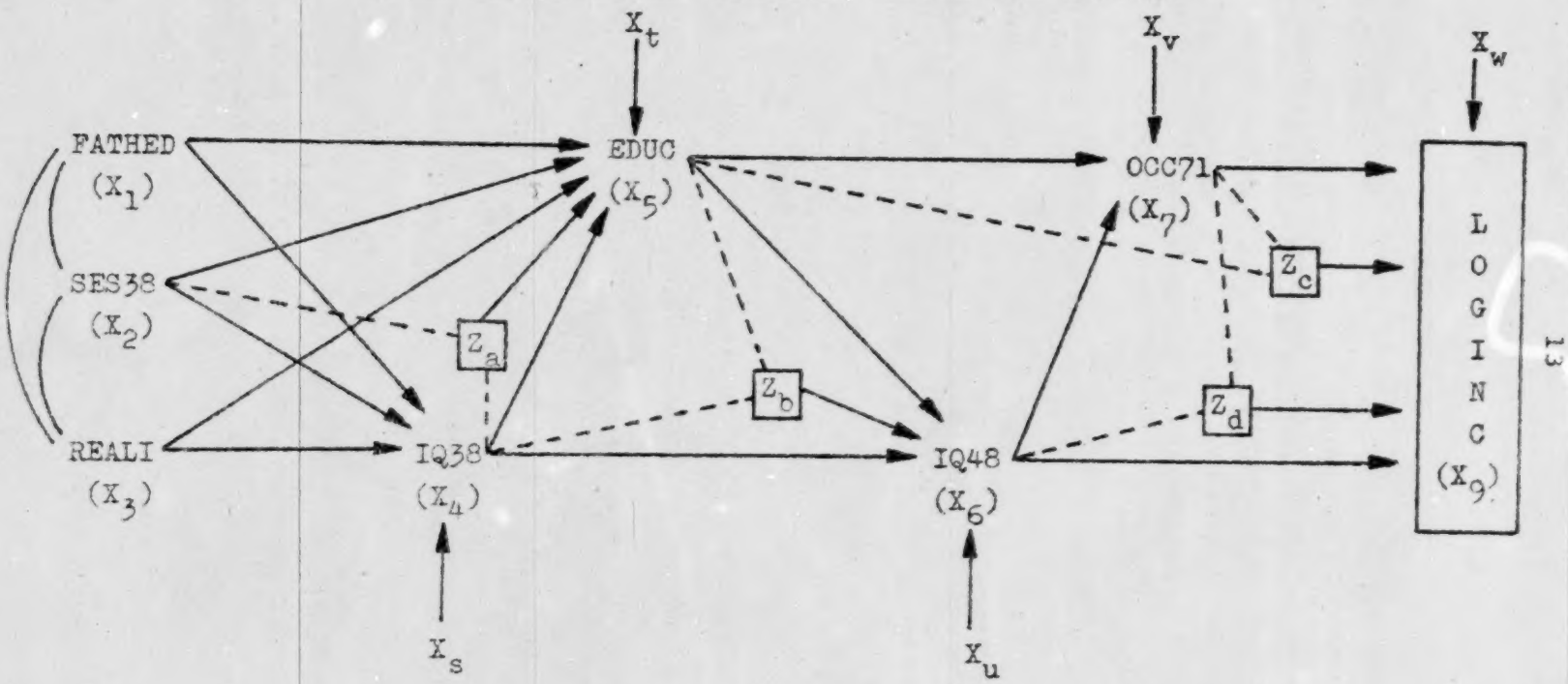
$$X_5 = p_{51}X_1 + p_{52}X_2 + p_{53}X_3 + p_{54}X_4 + p_{5a}Z_a + p_{5t}X_t \quad (2)$$

$$X_6 = p_{64}X_4 + p_{65}X_5 + p_{6b}Z_b + p_{6u}X_u \quad (3)$$

$$X_7 = p_{75}X_5 + p_{76}X_6 + p_{7v}X_v \quad (4)$$

$$X_9 = p_{96}X_6 + p_{97}X_7 + p_{9c}Z_c + p_{9d}Z_d + p_{9w}X_w \quad (5)$$

FIGURE 2: SCHEMATIC PATH DIAGRAM OF THE INCOME DETERMINATION MODEL INCORPORATING RESOURCE CONVERSION VECTORS[a]



a) The key to the mnemonics used is as follows: FATHED=father's educational level; SES38=composite index of the family's socioeconomic status in 1938; REALI=per capita family income; IQ38=respondent's mental ability in 1938, age 10; EDUC=type of schooling completed by the respondent; IQ48=respondent's mental ability at time of induction into armed services in 1948; OCC71=occupational status in 1971; LOGINC=the natural log of the respondent's pre-tax income (SKR1,000's) from all sources in 1971; Z_a=IQ38•SES38; Z_b=IQ38•EDUC; Z_c=EDUC•OCC71; Z_d=IQ48•OCC71.

3. DATA

The Malmö Data Set

Discussion of the Malmö data set will be fragmentary because more detailed discussions are presented elsewhere (Husén et al. 1969; Bulcock, Fägerlind and Emanuelsson, 1974). The original data from all 1,544 third graders (most were ten years old) in the private and public schools in the city of Malmö in southern Sweden were gathered by Dr. Siver Hallgren (1939) in 1938. At irregular intervals since then the data has been updated by carefully designed followup studies. A summary description of the data set is provided in Table 2. Three other matters are noteworthy. First, the original data were gathered in order to study the relationships between environment and cognitive ability. Secondly, official demographic and income data in Seeden is open to public perusal thus ensuring the accuracy of the variable measures. Thirdly, the usual case loss associated with followup studies has decreased over time, as individuals now in mid-career stream (most are forty-six years old) and less mobile, have become easier to trace through the facilities of the public record system. Thus, excluding deceased respondents, ninety-eight percent of the original sample members were traced in the 1972 data collection phase (Emanuelsson et al. 1973).

The Sample

In the original 1938 investigation Hallgren tested 835 boys and 709 girls. For present research purposes, however, only the male respondents have been used in the analysis. Income data for the 1971 tax year were available for 777 of the 835 males. Calculations on the total number of male respondents (N = 777) produced large discrepancies between R^2's using arithmetic values of income (SKR 1,000) and the natural logarithmic transformation of income, suggestive of an unusual 1971 income distribution. For example, an R^2 of .3636 was obtained for the arithmetic income measure, while an R^2 of .1703 was obtained for the log income measure.

Econometricians de Wolff and van Slijpe in their 1973 paper using the same data eliminated extremely high and extremely low 1963 income earners from the data set in order to offset the

TABLE 2: PHASES IN THE COLLECTION OF THE MALMÖ DATA SET 1938-1973

Date of Collection	Type of Data	Size of Sample	Source of Data	Mode of Collection	Principal Researchers
1938	Group intelligence test	1544 (835 boys, 709 girls)	All third grade children in Malmö public and private schools	Pencil and paper tests	Hallgren (1939)
1942	Types of school to which students transferred, and scholastic rating	440	All children transferred to junior secondary or higher school	Teacher ratings	Hallgren (1943)
1948	Social data, school marks, IQ test at maturity	613	All male respondents enrolled for military service	Military records, pencil and paper tests	Husén (1947, 1948, 1950); Husén and Henricson (1951)
1958-65	Criminality data, social assistance and education data	104 about 1500	Central criminal register Central welfare registers Malmö schools and National Central Bureau of Statistics	Public records	Husén, Emanuelsson, Fägerlind, and Liljefors (1969)
	Income data	1236	County tax departments	Public records	
	Social background data, adult education, and occupational career data	1116	Questionnaires	Mail	
1971-73	Adult education, data on occupations and working conditions	1077	Questionnaire	Mail	Emanuelsson, Fägerlind, and Hartman (1973)
	Social welfare and criminality data			Public records	
1974	Second generation data		School records Males enrolled for military service	School records Military records	

kind of problem described. The same procedure has been used here with the result that the R^2 differences between INC71 and LOGINC are small (Table 4). For the lower cut-off point an income of SKR 15,000 was chosen, and an income level of SKR 120,000 was chosen as the upper bound of the income continuum. Justification for these rather arbitrary limits is based on the assumptions: (1) that the lowest paid workers would normally have incomes higher than SKR 15,000 and (2) that the highest paid workers in 1971 would be unlikely to earn more than SKR 120,000. Incomes above that level would likely be supplemented by income from unearned sources - for example, capital gains, and legacies. The use of these cut-off points reduced the sample size from 777 respondents to 675 - a 102 case loss.

Variables and Interaction Vectors

The variables used in this report were gathered from a variety of sources. The 1938 data, for example, was gathered from taxpayers registers, population registers, social welfare registers and school classroom registers, all of which are official public documents. Pencil and paper intelligence tests were administered to school classes by Dr. Siver Hallgren in a test which he specially devised for the purpose, and which was administered under carefully controlled conditions. Supplementary data has been obtained from military records, classroom teacher records, and the National Central Bureau of Statistics in Stockholm; and in recent followups, by mailed questionnaire.

The father's educational attainment (FATHED) was not directly gathered in 1938 but reconstructed by expert judges familiar with the Malmö context. The educational component of a socio-economic variable described by Husén at al. (1969:56) was abstracted on the basis of the level of formal public and post-school training required to occupy a specific occupational status. The six category code, does not strictly represent years of schooling, but more accurately the level of schooling attained and the type of post-secondary training, which may be regarded for practical purposes as an attempt to bridge the quantity-quality gap in educational attainment.

The socioeconomic status of the family (SES38) was coded by Hallgren into four categories on the basis of four data items - the 1937 occupations of the parents, 1937 family income, the number of children at home, and the "occurrencies" in the social welfare register. Husén et al. (1969: 43) draws attention to the heavy weighting given to occupational criteria in this composite measure.

The real income of the family or the per capita family income (REALI) was a transformed variable based on parental income divided by family size. The 1937 parental income was obtained from the local tax register. It included both father's and mother's earnings plus any income from capital investments and other measured sources. The subsequent data was broken down into a ten point scale of unequal intervals.[11] Family size included foster children as well as the children of the biological parents, who were under 16 and living at home in 1938 according to population registers, plus the parents.

The assessment of cognitive ability (IQ38) was based on the Hallgren (1939) group intelligence test. It was of the standardized mental ability test variety (IQ = 100 (MA/CA)), and especially designed for the original Malmö study. Mental ability at maturity (IQ48) was the military IQ test administered to male respondents at the time of induction.

A four point educational attainment scale (EDUC) was based on the type of schooling obtained by respondents in the horizontally differentiated educational system in operation in Sweden in the '30's, '40's, and '50's, as described by Paulston (1968).[12] These ordinal categories can be regarded as levels of schooling attained rather than years of schooling, since each level corresponds to a type of schooling: "Folkskola", "realskola" or vocational school, "gymnasium", and university. For this reason it may be regarded as a surrogate for the quality of schooling attained.

Questionnaire data gathered in 1971/72 were the basis for the construction of occupational statuses (OCC71). Male respondents were classified into six ordinal categories.[13] The income data (INC71 and LOGINC) from the central tax register were based on incomes from both earned and unearned sources. The information was recorded to the nearest SKR1,000. The LOGINC variable is the natural log of INC71.

The concept of interaction will not be discussed here. Sound treatments can be found elsewhere (e.g. Blalock, 1968; Sonquist, 1970). According to orthodox interpretations the relationship between two variables which depends upon the value of a third is the classical case of interaction. In this case the third variable is the "conditioning" factor and prototypally is found in the context where individuals with a certain level of one attribute are affected differently by an environmental setting (condition) than individuals with different levels of the same attribute. Thus, where an environment affects individuals differently there is a conditional relationship or interaction effect (Harper, 1961; Sonquist, 1970:44). Interaction Z_a is a test to see whether the relationship between early ability (IQ38) and educational attainment (EDUC) is different for individuals from different socioeconomic environments (SES38). The test consists simply of determining whether the multiplicative effect of IQ38 and SES38 on EDUC, the dependent variable, is over and above their combined independent or additive effect. If it is, then it can be concluded in this particular instance, that the relationship between ability and educational attainment depends on the value of the family socioeconomic environment. In this example the interaction vector Z_a equals IQ38 multiplied by SES38 which must be added to the equation. Of course, the variables IQ38 and SES38 while having nonadditive effects on EDUC may have additive effects on other endogenous variables in the system.

Parallel logic accounts for the remaining interaction vectors Z_b, Z_c, and Z_d (Figure 2) where Z_b = IQ38 x EDUC; Z_c = EDUC x OCC71; and Z_d = IQ48 x OCC71. The verbal exposition of the interactions was presented above in the main theory section.

4. FINDINGS

The findings are presented under three headings. Since the first eight hypotheses have been discussed elsewhere by the authors (1974), and since in this research there are no divergencies from that reported earlier, only hypothesis 6 out of the first seven will be selected for examination. This is the hypothesis dealing with returns to schooling. Secondly, the findings related to the four resource conversion hypotheses will be presented. Lastly, the perceived adequacy of the model will be treated impressionistically and cursorily. The matrix of correlations presented in Table 3 constitutes the raw data for all subsequent analyses.

It will be noted that most of the variables were standardized prior to constructing the interaction vectors and prior to conducting regression analyses for hypothesis testing purposes. One of the pitfalls inherent in testing for the presence of statistical interaction stems from the tendency when multiplying interval-type variables with a wide numerical range, such as IQ measures, with ordinal-type measures which have narrower ranges, such as the schooling variable (EDUC) in this analysis, for their subsequent associations to be artifactually inflated. In order to eliminate this possibility the variables used in the construction of interaction vectors were standardized. Those variables standardized for this purpose have been given the prefix "ST" in subsequent reporting; thus, the variable "IQ38" becomes "STIQ38" in its standardized form. This is an important limitation as Linn and Werts (1969:310) point out, insofar as reporting the findings is concerned because it precludes the possibility of conducting an elasticities analysis in terms of raw variable units; that is, it prevents interpretation of the raw coefficients in terms of the dependent variable metric.

Returns to Schooling

It was hypothesized (hypothesis 6) that there would be negligible direct effects of schooling on earnings; that rather, the effect of schooling on earnings would be mediated by job status and ability at maturity. The findings related to this hypothesis are

TABLE 3: CORRELATIONS, MEANS, AND STANDARD DEVIATIONS OF VARIABLES IN THE EXTENDED MALMÖ MODEL OF THE SOCIOECONOMIC CAREER INCORPORATING INTERACTION VECTORS (N=675)[a]

VARIABLE	X_1	X_2	X_3	X_4	Z_a	X_5	Z_b	X_6	X_7	Z_c	Z_d	X_8	X_9	Mean	SD
X_1 STFATHED		.560	.365	.215	.135	.429	.167	.267	.304	.213	.125	.282	.274	0.0	1.0
X_2 STSES38	627		.581	.270	.126	.475	.175	.373	.348	.266	.109	.346	.331	0.0	1.0
X_3 REALI	604	616		.197	.189	.404	.281	.296	.262	.323	.223	.311	.288	0.816	0.778
X_4 STIQ38	646	642	615		-0.061	.390	.068	.742	.348	.173	.012	.379	.378	0.0	1.0
Z_a (X_4*X_2)	624	642	613	642		.192	.492	-0.078	.095	.221	.267	.126	.096	0.267	0.951
X_5 STEDUC	524	521	497	541	518		.399	.564	.578	.574	.343	.576	.562	0.0	1.0
Z_b (X_4*X_5)	521	518	494	541	518	541		.110	.230	.517	.469	.288	.243	0.380	0.993
X_6 STIQ48	541	538	517	560	538	457	457		.529	.239	.002	.500	.492	0.0	1.0
X_7 STOCC71	499	495	476	515	493	464	462	423		.232	.100	.627	.644	0.0	1.0
Z_c (X_5*X_7)	449	445	426	462	443	464	462	387	464		.618	.416	.357	0.585	1.081
Z_d (X_6*X_7)	410	408	394	423	408	387	387	423	423	387		.313	.234	0.492	0.965
X_8 INC71	649	645	618	672	642	544	541	560	517	464	423		.965	41.744	17.543
X_9 LOGINC	649	645	618	672	642	544	541	560	517	464	423	675		3.656	0.379

a) Correlation coefficients are above the diagonal. The figures below the diagonal represent the case base for each correlation coefficient. Underlined coefficients are not statistically significant at the p LT .01 level. With the exception of REALI, INC71, and LOGINC all variables have been standardized with zero means and standard deviations of one. Thus, all interaction terms were computed from standardized variables. The key to the mnemonics used is as follows: FATHED=father's educational level; SES38=composite index of the family's socioeconomic status in 1938; REALI=per capita family income; IQ38=respondent's mental ability in 1938, age 10; EDUC=type of schooling completed; IQ48=respondent's mental ability at maturity (age 20), at the time of induction into the Swedish armed forces 1948; OCC71=occupational status in 1971; LOGINC=the natural log of the respondent's pre-tax income (SKR1,000's) from all sources in 1971; INC71=respondent's pre-tax income from all sources 1971; Z_a=IQ38*SES38; Z_b=IQ38*EDUC; Z_c=EDUC*OCC71; Z_d=IQ48*OCC71.

presented in Table 4 which provides the structural coefficients for the conceptual model diagrammed in Figure 2. It will be noted that use of the LOGINC variable rather than the arithmetic metric of the INC71 variable provides the more conservative estimates of model relationship. Differences in the coefficients between equations using different measures of the income variables are not great. In the LOGINC column of Table 4 the structural relations for the regression of earnings on five predictors are presented. The path coefficient (p_{95} = .130) for the direct effect of schooling (STEDUC) on earnings (LOGINC) is not significant at the five per cent level. The comparable coefficient (p_{85} = .102) for the regression of INC71 on the same five predictors is significant at the .05 but not at the .01 level. In statistical terms the result is not clear cut. If we look at R^2 differences, or at substantive differences, there is a difference of .0067 between a full model with STEDUC included and the restricted model with STEDUC excluded.[14] Given the sensitivity of F-ratios to sample size it is most likely that, with a larger sample using the same cut-off points for below normal or super normal incomes, the schooling effects would become statistically significant at the .01 level. In substantive terms, however, we do not regard the effect of a model component which is not much more than half of one per cent, particularly noteworthy in comparison to the powerful effects of other variables. Thus, we accept hypothesis 6 as formulated in the "null" form, and use the reduced form of the extended Malmö model, with the direct path "p_{95}" in Figure 3 eliminated, in all subsequent analyses.

Resource Conversion Hypotheses

The four resource hypotheses were supported by the evidence. Use of the conventional F-test showed them all to be significant at better than the .01 level. With the exception of the small negative path coefficient for the interaction effect of schooling across early ability on ability at maturity (Z_b) all the relative effects of the interaction vectors were strong. The Z_c and Z_d interactions were considerably enhanced in the reduced form

TABLE 4: STRUCTURAL COEFFICIENTS FOR THE EXTENDED MALMÖ MODEL OF THE SOCIOECONOMIC CAREER: (I) RAW REGRESSION COEFFICIENTS, (II) PATH COEFFICIENTS, (III) STANDARD ERRORS[a]

	DEPENDENT VARIABLES																	
	STIQ38 (X_4)			STEDUC (X_5)			STIQ48 (X_6)			STOCC71 (X_7)			INC71 (X_8)			LOGINC (X_9)		
PREDICTORS	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
X_1 STFATHED	.090	.090	.059	.191	.191	.050	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
X_2 STSES38	.187	.186	.068	.194	.194	.057	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
X_3 REALI	.072	.056	.077	.183	.142	.065	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
X_4 STIQ38				.277	.277	.043	.608	.607	.033	.00	.00	.00	.00	.00	.00	.00	.00	.00
Z_a (X_2*X_4)				.138	.132	.044	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
X_5 STEDUC							.357	.357	.036	.394	.394	.058	1.790	.102	.987	.049	.130	.022
Z_b (X_4*X_5)							-0.075	-0.074	.034	.00	.00	.00	.00	.00	.00	.00	.00	.00
X_6 STIQ48										.302	.302	.049	3.345 (3.887)	.191 (.222)	.812 (.758)	.060 (.075)	.158 (.197)	.018 (.017)
X_7 STOCC71													7.456 (8.033)	.425 (.458)	.807 (.744)	.173 (.189)	.457 (.498)	.018 (.016)
Z_c (X_5*X_7)													1.777 (2.407)	.110 (.184)	.846 (.773)	.028 (.045)	.080 (.130)	.019 (.017)
Z_d (X_6*X_7)													3.052 (3.192)	.168 (.176)	.841 (.840)	.037 (.041)	.094 (.104)	.019 (.019)
REGRESSION CONSTANT		-0.059			-0.186			.028			-0.013			39.203 (38.766)			3.622 (3.610)	
$100R^2$		8.075			36.469			64.389			39.463			51.891 (51.476)			49.467 (48.793)	
RESIDUAL		.959			.797			.597			.778			.693 (.696)			.711 (.715)	

a) Note that the underlined path coefficients are not significant at the .01 level. The raw regressions, path coefficients, and standard errors in columns I, II, and III of the INC71 andLOGINC columns which are enclosed in brackets are for the reduced form of the model as presented in Figure 3; that is, one in which the direct path (P_{58}) from schooling (STEDUC) to earnings (LOGINC) has been deleted.

version of the model in which the direct path from schooling to earnings was eliminated. The effects of interaction vectors are presented in diagram form in Figure 3.

Model Adequacy

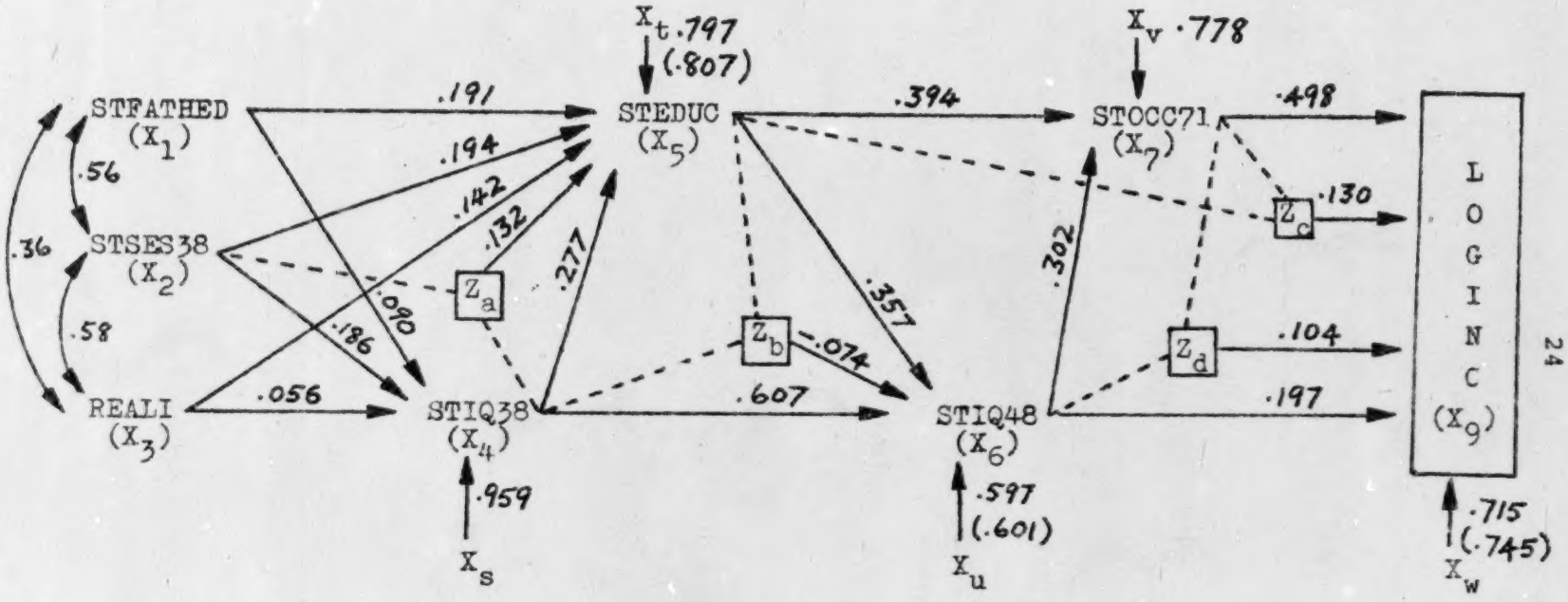
A problem plaguing the analyst has been the modest predictive power of large scale income determination models. The R^2 coefficients for the six models in Table 1 are representative of this fact. It is reassuring, therefore, that after eliminating non-normal incomes that the present model (Figure 3) accounts for almost half the variance in individual earnings (R^2 = .4879). Thus, the predictive power of the model is doubled over that of prior comparable models.

5. DISCUSSION AND CONCLUSION

The Impact of Schooling

That there is probably no question in the sociology of education more controversial than that concerning the impact of schooling is borne out by Spady's (1972) review and the reaction to the work of the researchers at the Center for Educational Policy Research, Harvard University (Harvard Educational Review Reprint, 1973). The findings of the authors both in this and earlier studies are supportative of those of Jencks and his colleagues insofar as the impact of schooling is concerned. The finding that the effects of schooling on earnings at mid-career stream are mediated by two important intervening factors - ability at maturity and occupational status - means that, although the direct effects of schooling may be small or negligible, the total indirect effect (TIE) on income may be considerable ($r_{95} - p_{95}$ = .56 - .13 = .43).[15] It also implies that models which fail to allow for the potentially powerful mediating effects of these intervening variables are probably seriously misspecified. This last point applies to a number of recent studies dealing with the relationship between income and schooling.

FIGURE 3: PATH DIAGRAM OF THE EXTENDED MALMÖ MODEL OF THE SOCIOECONOMIC CAREER INCORPORATING THE RESOURCE CONVERSION VECTORS[a]



a) The key to the mnemonics used is as follows: STFATHED = father's educational level; STSES38 = composite index of family socioeconomic status in 1938; REALI = per capita family income; STIQ38 = respondent's mental ability 1938, age 10; STEDUC = type of schooling completed; STIQ48 = respondent's mental ability at time of induction into military service in 1948; STOCC71 = occupational status 1971; LOGINC = natural log of pre-tax income (SKR1,000's) from all sources 1971; Z_a = STIQ38*STSES38; Z_b = STIQ38*STEDUC; Z_c = STEDUC*STOCC71; Z_d = STIQ48*STOCC71. Note that all variables were standardized prior to constructing interaction terms. The bracketted residuals constitute the disturbance terms for the additive effects only.

Resource Conversion Properties

According to the findings we conclude that in Sweden (at least for males born in the latter half of the 1920's) the major resource conversion settings in the prolonged process of socio-economic career attainment constitute environments which condition the relationships between selected resource inputs and desired outcomes of the conversion process. Thus, in the present research it was found that the association between personality resource assets and some outcomes such as educational attainment, ability at maturity, and earnings, depended upon the qualities and values inherent in the type of resource conversion setting. Though the particular processes involved in the conversion settings themselves could not be identified, since the gross characteristics of the variables gathered from official and mailed questionnaire sources preclude the possibility of getting at the fine-grain effects of interpersonal environments, there was evidence that the process was one of multiple advantage. This process is characterized by the tendency for those individuals with the personal resources to benefit from the environmental conditions at one stage of the career attainment process to acquire additional assets that will account for their differential treatment in subsequent environmental settings - a process of multiple advantage since the different treatment usually enables them to do better in the future. Further as the model shows, these relationships are not merely additive but multiplicative in nature.

Given the starting point of the extended Malmö model of the status attainment process the first interaction effect noted was between the early ability of the respondent and his home socio-economic circumstances. The strong positive association between ability and type of schooling is different for pupils from different socioeconomic environments; the difference being most favourable for those from high SES backgrounds.

The statistical model used for testing these hypotheses was a conservative one for two reasons. First, analysis of covariance

would provide more accurate estimates of the independent effects of environmental categories across a range of personality inputs as a concomitant variable. Secondly, incorporation of nonlinear or curvilinear terms in the equations might capture the relationships more accurately and especially if, as is suspected, floor and ceiling effects are operative. Prudence dictated otherwise, however, since the more conservative test conducted here was an important prerequisite for establishing the justification for the use of these rigorous procedures.

The negative coefficient for the effect of the interaction of early ability and educational attainment on later ability was not anticipated. It may be indicative of the presence of curvilinear relationships within the model, but more likely it is indicative of talent loss in the horizontally integrated Swedish education system prior to implementation of the comprehensive school reforms in the '60's. The unexpected negative coefficient is one interaction that would seem to be worth while examining more closely in a model where the educational categories are inputted as dummy variables thereby facilitating the graphical display of the regression slopes.

The remaining interactions concerned the effectiveness of occupational categories as resource conversion settings. In the first of these (Z_c), the variable "educational attainment", which earlier had been conceived of as an outcome factor, was conceived of as a personality resource input. A highly significant beta of .130 for their interaction clearly indicates that the effectiveness of education as a determinant of earnings differs according to the job category. What the actual effect of each job category is, and the nature of the difference of the effects from one job category to another is still unknown.

A similar logic applies to the second of the interactions with occupational status (Z_d). Ability at maturity has different effects on earnings for different job categories but a more exact description of the relationships between ability levels, job categories, and earning power is dependent on future research.

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FOOTNOTES

1. The research reported in this paper was conducted while the first author was a research fellow at IEA International, University of Stockholm. Financial support was provided by the Spencer Foundation and the Institute for the Study of International Problems in Education, University of Stockholm. The authors wish to thank C. Arnold Anderson, Mary Jean Bowman, Jeremy D. Finn, Zvi Griliches, Robert M. Hauser, Christopher Jencks, and Joe L. Spaeth for critical comments and suggestions on earlier papers in this series of studies; and Spencer Fellows Zoltan Bathory and Kimmo Leimu, cosponsers of the IEA noon hour colloquia at the University of Stockholm, where these ideas were first presented and critically examined.

2. Excellent reviews of the recent literature are available: Welch (1974); Hauser (1973b); Spaeth (1974a).

3. The notion of a paradigm shift is Kuhnian, and refers to that complex of metaphysics, action theory, and methodology which forms the coherent background to the science of a particular time period, and which is usually given concrete expression in archetypal scientific work; for example, Einstein's "general theory of relativity", or (perhaps) Hull's "principles of behavior". A paradigm-shift, then, is explicable in terms of a transition from one paradigm "the Old" to another, "the New". The major difference characterizing "the New" is the use of multi-causal models which implicitly or explicitly invoke the principle of covariance. Since covariance analysis was a discovery of the British statistician and geneticist R.A. Fisher in the early 1920's, there would seem to be some justification for comparing his work viz-a-viz the social and biomedical sciences with that of fellow-countryman Isaac Newton viz-a-viz the physical sciences and engineering.

4. See for example, the earlier work of Mincer (1958, 1962), and his more recent review of the theoretical literature (1970), or the work of Becker (1964, 1967), and Becker and Chiswick (1966). For an edited collection of papers see Hansen, ed. (1970). Recent empirical work includes: Daniere and Mechling (1970), Griliches (1970), Hansen, Weisbrod, and Scanlon (1970), Johnson (1970), Reed and Miller (1970), Hause (1971, 1972), Arrow (1972), Griliches and Mason (1972), de Wolff and van Slipje (1973), Taubman and Wales (1973), Chamberlain and Griliches (1974).

5. A collection of papers on the process of socioeconomic attainment is forthcoming, Sewell, Hauser, and Featherman (eds.), (1974). The "classical" works are Blau and Duncan (1967) and Duncan, Featherman, and Duncan (1968). Recent empirical studies in this vein include: Sewell and Shah (1967, 1968), Duncan (1968a, 1968b), Featherman (1969), Sewell, Haller and Portes (1969), Hauser (1970), Jones (1971), Sewell, Haller, and Ohlendorf (1970), Hauser (1971), Sewell (1971), Blum (1972), Coleman, Berry and Blum (1972), Duncan, Featherman, and Duncan (1972), Featherman (1972), Hauser (1972), Jencks et al. (1972), Sewell and Hauser (1972), Hauser, Sewell, and Lutterman (1973), Kelley (1973), Kohn and Schooler (1973), Meuller (1975), Bulcock, Fägerlind, and Emanuelsson (1974), Spaeth (1974a, 1974b).

6. A similar but not identical report comparing Swedish and U.S. findings in the socioeconomic career attainment literature has been written by the authors in Swedish (Fägerlind, Emanuelsson, and Bulcock, 1974). References in this paper will be exclusively to the English version. See also Emanuelsson (1974) for a multiple classification analysis of 1963 income data from the Malmö data set. Emanuelsson also detected strong interaction effects present in the system of career attainment variables.

7. The data sets examined were: (1) to (4) Occupational Changes in a Generation for (A) 25-34 year olds, (B) 35-44 year olds, (C) 45-54 year olds, and (D) 55-64 year olds (Duncan, Featherman, and Duncan, 1972); (5) Current Population Survey 1964 (CPS) of post WWII veterans (Griliches and Mason, 1972); (6) and (7) synthesized data sets mainly from CPS, 1964-NORC, and CPS-OCG 1962 (Duncan, 1968), and (Jencks et al. 1972); (Kohn, 1969; and Kohn and Schooler, 1973).

8. What is referred to as the basic Blau-Duncan (1967) model of occupational achievement has been extended in recent years in four directions. Extensions have been made to the background variables such as family size and stability (B. Duncan, 1965; 1967; Duncan, 1968a; Duncan, Featherman, and Duncan, 1972), family environment (Hauser, 1973), ethnicity, race, and religion (Duncan and Duncan, 1968; Duncan, 1968b; Gockel, 1969; Goldstein, 1969; Warren, 1970; Featherman, 1971; Duncan, Featherman, and Duncan, 1972; Duncan and Featherman, 1972), and urbanization and region (Featherman, 1971b; Meuller, 1973). Secondly, in addition to education, a number of variables intervening between background factors and socioeconomic achievements have been incorporated into the model, including motivation and ambition (Crockett, 1966; Duncan, 1969a; Duncan, Featherman, and Duncan, 1972; Duncan and Featherman, 1972; Featherman, 1972), aspiration, and ability (Sewell, Haller and Ohlendorf, 1970; Duncan, 1968a; Duncan, 1969b; Jencks et al., 1972), the interpersonal influences of wives, mothers, peers, and "others" in the school context (Alexander and Campbell, 1964; Duncan, Haller, and Portes, 1971; Duncan, Featherman, and Duncan, 1972; Nelson, 1972), and migration (Blau and Duncan, 1972). Thirdly, there have been attempts to examine the effects of proximate career contingencies such as age, first job, and age at first job (Duncan, 1965; Blau and Duncan, 1967), and such job characteristics as work experience, size of firm, number of subordinates, and job complexity (Kohn, 1969; Kohn and Schooler, 1973; Spaeth, 1973a). Fourthly, the model has been extended to include additional

outcome variables such as occupation and income at successive stages in the life cycle (Blau and Duncan, 1967; Duncan, Featherman, and Duncan, 1972; Featherman, 1971c; Kelley, 1973).

9. See footnote 5 for examples.

10. As a rider to hypotheses 1-3 attention is drawn to the growing body of evidence that family background characteristics such as father's and mother's education, father's occupation, family income, and family size are poor surrogates for measures of the interpersonal dimensions of family environments. The theoretical discussions of the relationship between family SES and ability by Bloom (1964) and more recently by Spaeth (1974b) are relevant. For empirical support see Williams (1973a, 1973b, and 1974).

11. The intervals were: (1) LT or EQ SKR 1,000, (2) SKR 1,001 - 2,000, (3) SKR 2.001 - 3,000, (4) SKR 3,001 - 4,000, (5) SKR 4,001 - 5,000, (6) SKR 5,001 - 7,500, (7) SKR 7,501 - 12,000, (8) SKR 12,001 - 20,000, (9) SKR 20,001 - 50,000, (10) GT SKR 50,000.

12. The ordinal categories were: (1) Folkskola or LT eight years of schooling, (2) eight to ten years of schooling, including some Realskola or Vocational school, (3) eleven to fourteen years of gymnasium-level academic education, (4) fifteen or more years of formal full-time schooling including university.

13. These were: (1) unskilled workers, (2) semiskilled manual workers, (3) skilled blue-collar, (4) foreman or the equivalent, (5) senior clerical and service personnel, (6) leading positions, and members of established professions.

14. The formula used for the calculation of the F-ratios of regression coefficients was $(B/S)^2$: where, B = the "raw" regression coefficient; and S = the standard error of B.

Using the alternative formula:

$$F = \frac{(R^2_f - R^2_r)/(m_1 - m_2)}{(1 - R^2_f)/(N - m_1)}$$, where R^2_f and R^2_r refer to the full and restricted models; m_1 and m_2 refer to the number of linearly independent vectors in the full and restricted models, we obtain an F = 3.296 for INC71, and an F = 5.125 for the LOGINC model. Thus, the inclusion of STEDUC is significant at the .05 level in the LOGINC model, but not statistically significant (p GT .05) in the INC71 model; which is the reverse of the finding reported in the text.

15. The TIE estimate is probably on the liberal side in view of the exceptions to the formula discussed by Finney (1972) and Charner and Cohen (1973). In our judgement it is an acceptable estimate.

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